IN THE UNITED STATES DISTRICT COURT
DISTRICT OF MONTANA
BILLINGS DIVISION

GIACOMETTO RANCH INC., et al., Plaintiffs,	)	Case No. 1:16-cv-00145
v.	)	
DENBURY ONSHORE LLC, et al., Defendants.	)	DECLARATION OF PAUL BUTTON

Pursuant to 28 U.S. Code § 1746, I hereby declare the following:

1. My name is Paul Button. I am employed as consulting petroleum engineer. I have held this position for 3 years. A complete statement of my background qualifications is attached as Exhibit A, which is a current copy of my C.V.
2. I have been retained by the plaintiffs in this case as an expert petroleum reservoir engineer to assist them with all aspects of their case. My role working with the plaintiffs is two-fold. First, I am consulting with the Plaintiffs and advising them regarding the information that they will need to obtain to prove their claim. Second, I have been retained to provide an expert report and opinion regarding Denbury's use of the Giacomettos' pore space,

and specifically to determine whether Denbury's use of this pore space is reasonable for oil production.

3. I have been a reservoir engineer for 23 years. During this I have worked a variety of tertiary projects from a pattern CO_2 flood at SACROC Unit Texas to gas oil gravity drainage projects at Poplar Dome, Montana and Yates Field Unit in Texas. I have also worked with the Enhanced Oil Recovery Institute at the University of Wyoming to evaluate numerous fields in Wyoming for potential miscible and immiscible CO_2 floods. I am familiar with CO_2 projects from initial screening feasibility studies, to implementation and operation.

4. Denbury is currently performing a CO_2 flood on Bell Creek field, in part, to enhance the oil recovery after periods of primary and secondary recovery. Denbury has secured a CO_2 source and built the pipeline infrastructure to deliver CO_2 to the field. I have not studied the progress of the flood to determine the effects of the flood at this time.

5. Most CO_2 floods used for enhanced oil recovery are operated at sufficient pressure to achieve miscibility as the recovery of oil is greater under miscible conditions. The minimum miscible pressure is an important consideration when designing a CO_2 flood, because this is the point where interfacial tension between the CO_2 and the oil is minimized and the two fluids form a homogenous fluid within the reservoir. If the reservoir conditions maintain

miscibility, the flood will result in increased displacement and lower residual oil left in the reservoir compared to projects operated below the minimum miscibility pressure (MMP). Most CO_2 floods are designed to operate at sufficient reservoir pressure that miscibility is achieved from the injector to the near wellbore area around the producer. Most CO_2 projects achieve miscibility during the flood either initially or through multi-contact miscibility, but operators rarely purposely increase the reservoir pressure very much above the MMP as the increased pressure increases the CO_2 utilization in the reservoir and lowers the profitability of the project.

6. As background, I understand that the plaintiffs have requested certain information from Denbury in discovery, including Carbon Dioxide purchase agreements and transport agreements. This information is critical to understand the terms of the CO_2 injection, whether the buyer or seller of the CO_2 is expected to pursue CO_2 credits, how those credits may be divided, how long CO_2 will be stored in the pore space, and ultimately, whether the CO_2 is incidental or incremental (i.e. sequestered permanently for purposes of storage).

7. Although I understand that the plaintiffs have not been provided these agreements and therefore I have been unable to review these agreements, I have nonetheless reviewed a number of documents from the Plains CO_2

Reduction Partnership ("PCOR") at the University of North Dakota's Energy & Environmental Research Center regarding Denbury's operations in the Bell Creek Field. These materials are extensive. Many of these materials include presentations from Denbury presenters, as well as technical publications from EERC. I understand that the plaintiffs obtained these materials through an open records request to EERC.

8. My understanding is that my expert report and opinion in this case is not due until November 20, 2020. Nonetheless, based upon my review of the EERC/PCOR documents and based upon my knowledge and expertise, I have the following initial thoughts and opinions:

    a. The CO_2 flood at Bell Creek has been extensively studied. From the documents reviewed, the scientific rigor especially during the monitoring portion of the flood is quite unusual and expensive. Certain portions of the monitoring are very extensive and beyond what a typical oil company would perform on a project of this scope. Significant amount of expenditures seemed to be directed at detecting CO_2 containment in the reservoir which is above and beyond most typical CO_2 floods. Examples of the projects that seems to be excessive are the micro-seismic monitoring, InSAR deformation analysis, and the degree of ground water monitoring

b. Based on my experience, this level is scientific rigor is not reasonably necessary or particularly useful to operate an enhanced oil recovery project.

c. Rather, the purpose of this detailed scientific analysis seen as excess is to prove the effectiveness of the CO_2 sequestration. The monitoring, verification and accounting portion of the project (known as "MVA") is specifically designed to prove the viability of CO_2 sequestration. The clear purpose of this research is to prove that Denbury is permanently sequestering CO_2. This type of scientific work is valuable to obtain tax credits and obtaining tax credits is the primary reason that I believe a company would pursue this rigorous level of study.

d. Based on the fact that this research is focused extensively on the MVA research, it is further my initial opinion that Denbury intends to permanently sequester CO_2 in the Giacomettos' pore space without removing CO_2 from the Giacomettos' pore space.

e. EERC created a reservoir simulation model of the Enhanced Oil Recovery project. I expect that my expert opinion will be based in part on this model and whether Denbury has deviated from this model. The 3D simulation model was developed based upon typical engineering and geological inputs, and presumably data for the Bell Creek field such

as reservoir structure, thickness, porosity, reservoir fluid properties, saturations, pressures, absolute permeability and relative permeability. The reservoir description and historic production were used to constrain the model's relative error and provide confidence in the predictive ability. Several prediction runs were run with variation in the injection rate and with and without WAG (water alternating gas) cycles. The results of these model runs will constrain the analysis of the pore space utilization. The 3D simulation model used in project scoping and potentially updated to match CO_2 flood results will give an accurate picture of the oil, water and gas saturations and pressures in the reservoir at flood commencement and at field abandonment conditions. The information provided in the model is critical to form an opinion on whether Denbury is reasonably using the pore space for oil production.

f. It is technically feasible to remove a portion CO_2 from pore space. This operation is commonly referred to in the industry as a blowdown operation. Typically, blowdown operations are conducted toward the end of economic life of the field if the CO_2 can be commercially used in another field. I don't expect Denbury to complete a blowdown operation here because it appears that Denbury intends to perpetually store CO_2 in the pore space of the Bell Creek Field. In my experience,

it would be unusual to leave the CO_2 sequestered in the reservoir if a commercial case existed that was higher value than the original source.

g. I understand that Denbury has gas processing equipment installed at Bell Creek that is capable of CO_2 separation. It would be helpful for me to inspect this equipment in the discovery process of this case before I prepare my expert opinions and report. However, even without personally looking at this equipment, my initial opinion at this point is that this equipment can be used to process CO_2 produced from the Giacomettos' pore space and that this CO_2 could then be marketed transported for use in another oil field, such as the Cedar Creek Anticline.

9. As discovery proceeds, I expect to be able to more fully form these opinions and to base these opinions on actual information from Denbury. Apart from the above-described EERC model, I expect that the following information is in Denbury's possession and will be critical for me to provide a complete and informed opinion. Specifically, I need the following data and information from Denbury so that I can adequately perform an evaluation of the pore volume utilization during CO_2 EOR at Bell Creek Field, among other tasks for my report:

a. **3D numerical reservoir simulation model data decks, output files and graphing files.** These simulation model files and data decks are product of an extensive study performed by the operator and industry consortium to quantify the impact of CO_2 flooding on the Bell Creek Field. The simulation results would be the single best method to quantify the pore volume utilization. The model predicts the saturations, pressure, compositions and fluid mobility at discrete timesteps throughout history and during the prediction of the flood. The reservoir simulation model is the single best method to predict current and future pore volume utilization from the CO_2 EOR project.

b. **Structure maps of injection zone top, structure maps for major sub zones, and/or structure maps of confining zones.** Structure maps are maps created based upon formation tops from well logs, 3D seismic reflectors, and interpretation of geologic deposition environment to give a representation of the elevation change across the productive reservoir. The maps will be utilized to calculate head potential across the reservoir as well as determine if the structure in the model agrees with conventional mapping techniques.

c. **Complete set of gross and net thickness isopach maps for the injection zone.** These maps are generated based upon sand quantity

encountered during drilling as identified from well logs. Applying cut offs based on porosity, clay percentage, and water saturation allow for the net reservoir sand calculation which is an important for calculation of reservoir volumetrics. The gross and net sand isopachs will be compared to the gross and net reservoir thickness used in the simulation model.

d. **Pore volume (PV) maps and/or hydrocarbon pore volume (HCPV) maps of the injection reservoir.** These maps include the main injection zone and all subzones defined by the geologists. If HCPV maps are available based on different time realization (i.e. discovery, start of EOR flood, current time), I would want to review these as well. These maps will be the basis of volumetric calculations and determination of pore volume on an aerial basis. They will also be used to quality check the simulation model. The HCPV is also used to look at injection volumes and water alternating gas (WAG) cycles to determine the effectiveness of the CO_2 flood.

e. **Well logs from the area in LAS or other digital format**. The well logs are quantitative measurements that were taken of the formation before the well was completed. The well logs provide information such

as porosity, resistivity, minerology and fracture indication. The well logs will be used to verify the mapping and simulation model input.

f. **Porosity, permeability, and saturation database for the field area.** A digital database or spreadsheet of data indexed to well name and API would be used to perform cross plot analysis to determine reservoir flow drivers. The database would be utilized to perform statistical analysis on individual reservoir parameters. The output would be compared to the simulation model input to make sure that the geologic realization in the model compares statistically to the properties observed in the reservoir.

g. **Water chemistry samples for produced and injected water.** Water chemistry data is collected upon completion and is often reported when applying for an injection permit. The water chemistry will be used to determine the gravity and pressure head in the reservoir of the water phase. The water chemistry will also be used in capillary pressure calculations to get a range on mobile water in the reservoir.

h. **Oil PVT analysis**. This would include both basic PVT studies and advanced tests such as CO_2 interaction tests including miscibility testing and swelling tests. If an EOS has been developed for the Bell Creek petroleum system, I would want to review the EOS parameter as

well as any comparison to PVT tests. The PVT tests are laboratory tests performed on oil at reservoir pressure and temperatures. The data will be used to understand the oil mobility and expansion capability as CO_2 is injected into the reservoir. The lab results will be cross checked against model inputs. This data is also crucial to performing material balance calculations on the reservoir.

i. **Material Balance calculations**. Material balance is a method of determining reservoir performance based on rock properties, fluid properties, pressure response, production, injection and aquifer influx or efflux. The material balance calculations will be used to determine the quality of the history match and determine if compartments exist in the reservoir.

j. **Reservoir Pressure data.** This would include all bottom hole pressure data collected during the history of the field. This would also include surface pressure data and fluid level measurements so a complete data set of the pressure history can be complied. The pressure data is very important to determine reservoir performance and to quantify the pore utilization. The pressure data will be used to verify the history match of the simulation model and material balance calculations.

k. **Cumulative and monthly production and injection data.** This would include all production data from the discovery of the field to the present by well, including oil, gas and water volumes when recorded as indexed to each well name and API number. For injection data, I would request monthly volumes for water and gas injectors with time. The data will be cross checked with simulation model. It will also be used in material balance calculations to determine reservoir performance.

l. **Completion report and/or completion data base used to construct the simulation model.** Completion information will include perf records and stimulation data. Perf data should have time stamps to account for any squeeze and or perf modifications. The data will be used to verify the simulation model well completion to verify the fluid is being produced or withdrawn from the correct zone in the reservoir.

m. **Relative permeability data.** This will include core test information for both oil water and gas oil core testing. I would want to review all tests if multiple cores have been tested. Relative permeability data is measured in the lab when the core is flooded with fluid or gas. The displaced fluid is measured at various stages during the test with the ratio of displaced fluid measured to determine mobilities at different core saturations. This data will be utilized in verifying the model input.

n. **Capillary pressure data.** I would want to review capillary pressure data for cores tested. Capillary pressure is lab measured data that measures the differential pressure between the wetting and non-wetting phase in the core. Pore throat size and wettability information for the reservoir. The capillary pressure data is important in calculating the initial saturation potential including connate water saturation. The capillary pressure data will be cross checked with the simulation model to verify the imbibition potential incorporated into the model.

o. **Original oil water and gas oil contact data for the reservoir.** The contacts are the interfaces between the oil and water or gas and oil in the reservoir. The contacts are used to initialize the model with the correct amount of oil originally in place. They are also used to calculate the volumetric oil in place. The contact information will be used to verify the inputs into the model and determine the extent of the transition zone.

p. **Core data.** Core data is lab test data from core recovered during the drilling of the wells. Rock samples are taken to determine porosity and permeability and saturation of the reservoir rock. These three measurements are considered routine core analysis. Special core analysis is rock mechanics data and any flooding data on native state or

aged core. I would want to review all core data including core descriptions. This data will be utilized in the pore utilization calculation to determine the variability in porosity and pore size that could affect recovery efficiency in the reservoir.

q. **Reservoir temperature data.** This would include all reservoir temperature data indexed to well name and API number. Temperature is measured when bottom hole pressure data is recorded. The temperature is used in volumetric calculations and effect the miscibility of CO_2 and oil. The data will be used to make sure that volumetric calculations are calculated at the proper temperature.

r. **Micro-seismic data and interpretations** Micro seismic is measurements of the sounds created as stress is relived in the reservoir rocks. As fluids are injected into the reservoir the stress in the rock changes as the pressure increases. As the stress is relieved the rocks tend to crack creating sound that can be recorded by an array of geophones cemented into wells. With the use of several arrival times at different geophones the location of the crack can be triangulated and identified. These tests are used to identify the influence area of the injection. This rock volume will be used in conjunction with the

simulation model to determine the pore volume effected by the CO_2 injection.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on (date): 3/17/2020

Signature: ______________________

Printed name: Paul Button